

# THE ZOOLOGIST

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## PLEISTOCENE AND LATER BIRD FAUNA OF GREAT BRITAIN AND IRELAND.

BY ALFRED BELL.

It may be of service to those interested in the history of the avifauna of Great Britain and Ireland to have for reference a digest of the scanty records of former bird-life left in the dens, caves, fens, clays, marshes, and river alluvia of these kingdoms, and in the shell mounds and refuse-heaps of our stone-using forerunners, and in the Celtic lake-dwellings, and on Romano-British dwelling-places.

Caves, as may be inferred, are the richest depositories of these remains. In those where the bones occur in two distinct layers or strata, these have a tendency to become intermixed, owing to the burrowing habits of Rabbits, Badgers, and Foxes. To the same animals and the Wild Cats we are probably indebted for the presence of the Common Fowl, Goose, Duck, and Pheasant, birds introduced by our Celtic and Roman invaders. The last newcomer, the Turkey, is more common in Ireland than in England, occurring in the upper layers of nearly every Irish cave deposit.

Very few birds are quoted from the older bone-caves of Derbyshire or of the south-west coast, so rich in the larger mammalia. It would seem from the success that has attended later workers that the rarity was due to a looser method of examining the cave *débris* rather than to their absence, as the early caves of Ballynamintra, Shandon, Castlepook, are all more or less productive.

Palæo-zoologists and ornithologists owe much to Mr. E. T. Newton, F.R.S., who has spared neither time nor trouble in the task of deciphering the hundreds if not thousands of bones submitted to him. It may be said that of the many caves referred to,\* there are only a few, and those of the earlier period, whose relics have not been through his hands. For my own part I have gratefully to acknowledge the help and assistance he has been to me in this paper and at other times.

Mr. A. S. Kennard, F.G.S., who is now investigating a richly fossiliferous fissure cave at Chudleigh (not McEnery's cave), has kindly permitted me to use his MS. list of birds, determined by Mr. Newton. The opening to the cave, which has been used as the eyrie of some small bird of prey for some years, is now some thirty feet above beach, but must formerly have been more accessible, as the bones of Pig, Ox, and Red Deer suggest human occupation. The mammalian bones now under examination contain the Tailless Hare (*Pika*), and carry it back to Mid-Pleistocene Age.

The bird bones from the Mammoth Cave at Castlepook, near Doneraile, Co. Waterford, are in hand, and a list will be published in due course.

The writer's thanks are due to Messrs. J. H. Gurney, Kennard, Jackson, Dr. Scharff, and the late R. T. Ussher, Rev. E. H. Mullins, Dr. Male, and many other friends, who have furnished him with much information and help in making the list so complete.

#### POST-TERTIARY BIRDS.

MISTLE-THRUSH (*Turdus viscivorus*, L.).—*Caves*: Wye Valley, Chudleigh; ? Grimes Graves. Ireland: Doneraile, Kesh, Edenvale.

SONG-THRUSH (*T. musicus*, L.).—*Caves*: Clevedon, Chudleigh, Langwith Bassett, Ightham. Ireland: Kesh, Edenvale, Bantick, Newhall.

REDWING (*T. iliacus*, L.).—*Caves*: Clevedon, Chudleigh, Longcliffe, Langwith Bassett. Ireland: Kesh (Plunkett), Edenvale, Bantick, Newhall.

\* The reader is referred to the Appendix for papers containing detailed information on the different caves, &c., and their contents, which have furnished the present material for this article.



FIELDFARE (*T. pilaris*, L.).—*Caves*: Ireland: Kesh and Edenvale.

BLACKBIRD (*T. merula*, L.).—*Caves*: Clevedon, Chudleigh, Langwith Bassett, Ightham. Ireland: Doneraile, Edenvale, Newhall, Kesh.

WHEATEAR (*Saxicola œnanthe*, L.).—*Caves*: Clevedon, Langwith Bassett, Ightham.

WHINCHAT (*Pratincola rubetra*, L.).—*Caves*: Carnforth, Chudleigh. Ireland: Kesh.

REDSTART (*Ruticilla phœnicura*, L.).—*Caves*: Chudleigh.

REDBREAST (*Erithacus rubecula*, L.).—*Caves*: Clevedon, Chudleigh, Longeliffe, Langwith Bassett. Ireland: Kesh, Newhall, and Edenvale.

NIGHTINGALE (*Daulias luscinia*, L.).—*Caves*: Langwith Bassett.

WHITETHROAT (*Sylvia cinerea*, Bechst.).—*Caves*: Chudleigh.

HEDGE-SPARROW (*Accentor modularis*, L.).—*Caves*: Chudleigh, Langwith Bassett, Ightham. Roman: Caerwent.

DIPPER (*Cinclus aquaticus*, Bechst.).—*Caves*: Chudleigh.

COAL-TIT (*Parus ater brittanicus*, S. & D.).—*Caves*: Chudleigh.

BLUE TIT (*Parus cœruleus*, L.).—*Caves*: Carnforth.

NUTHATCH (*Sitta cæsia*, Wolf.).—*Caves*: Chudleigh, Langwith Bassett.

WREN (*Troglodytes parvulus*, K. L. Koch).—*Caves*: Chudleigh.

TREE-CREEPER (*Certhia familiaris*, L.).—*Caves*: Chudleigh.

PIED WAGTAIL (*Motacilla lugubris*, Temm.).—*Caves*: Langwith Bassett, Chudleigh, Ightham. Ireland: Kesh (upper level), Edenvale (both levels).

MEADOW-PIPIT (*Anthus pratensis*, L.).—*Caves*: Langwith Bassett, Chudleigh, Ightham. Ireland: Kesh (top level).

ROCK-PIPIT (*A. obscurus*, Lath.).—*Caves*: Langwith Bassett, Chudleigh.

RED-BACKED SHRIKE (*Lanius collurio*, L.).—*Caves*: Ightham fissure.

SWALLOW (*Hirundo rustica*, L.).—*Caves*: Langwith Bassett, Ightham. Ireland: Kesh (both levels).

HOUSE-MARTIN (*Chelidon urbica*, L.).—*Caves*: Carnforth. Ireland: Newhall (top level).

GREENFINCH (*Ligurinus chloris*, L.).—*Caves*: Clevedon, Chudleigh. Ireland: Kesh.

HAWFINCH (*Coccothraustes vulgaris*, Pall.).—*Caves*: Chudleigh. Ireland: Newhall (top level).

GOLDFINCH (*Carduelis elegans*, Steph.).—*Caves*: Chudleigh.

HOUSE-SPARROW (*Passer domesticus*, L.).—*Caves*: Langwith Bassett, Chudleigh, Ightham. Ireland: Kesh, Edenvale (top levels).

CHAFFINCH (*Fringilla cœlebs*, L.).—*Caves*: Langwith Bassett, Ightham. Ireland: Kesh.

LINNET (*Acanthis (Linota) cannabina*, L.).—*Caves*: Chudleigh. Ireland: Kesh (Plunkett).

BULLFINCH (*Pyrrhula europæa*, Vaill.).—*Caves*: Ireland: Edenvale, Newhall (top levels), Kesh (lower levels).

CORN-BUNTING (*Emberiza miliaria*, L.).—*Caves*: Chudleigh.

YELLOWHAMMER (*E. citrinella*, L.).—*Caves*: Chudleigh. Ireland: Newhall.

STARLING (*Sturnus vulgaris*, L.).—*Caves*: Chudleigh. Ireland: Bantick (Co. Sligo), Edenvale and Newhall (Clare), Knockmore and Knockninny (Fermanagh), ? Grimes Graves.

CHOUGH (*Pyrrhocorax graculus*, L.).—*Caves*: Chudleigh.

JAY (*Garrulus glandarius*, L.).—*Caves*: Ireland: Kesh, Edenvale, Newhall.

MAGPIE (*Pica rustica*, Scop.).—*Caves*: Ireland: Castlepook, Edenvale, Newhall.

JACKDAW (*Corvus monedula*, L.).—*Caves*: Langwith Bassett, Chudleigh. Ireland: Kesh (top level), Edenvale, Newhall.

RAVEN (*C. corax*, L.).—*Caves*: Kirkdale, Clevedon, Langwith Bassett. Ireland: Shandon, Edenvale, Newhall, Bantick. Scotland: Linlithgow. Roman: Caerwent, Cranbourn Chase, Woodcuts, Lewes (Mount Caburn).

CARRION-CROW (*C. corone*, L.).—*Sub-Arctic*? : Dalling (Norfolk), Hastings (Kit. midd.). *Celtic*: Glastonbury.

ROOK (*C. frugilegus*, L.) or CROW.—*Caves*: Langwith Bassett. Ireland: Castlepook, Kesh (Plunkett), Edenvale, Newhall, Bantick.

SKY-LARK (*Alauda arvensis*, L.).—*Caves*: Kirkdale, Clevedon, Langwith Bassett, Chudleigh, Ightham. Ireland: Castlepook. *Celtic*: Barton Mere.

? SHORE-LARK (*Otocorys alpestris*, Jenym.).—*Caves*: Chudleigh.



GREAT SPOTTED WOODPECKER (*Dendrocopus major*, L.).—*Caves*: Langwith Bassett, Chudleigh. Ireland: Edenvale, Newhall, (top level).

SWIFT (*Cypselus apus*, L.).—*Caves*: Clevedon.

BARN-OWL (*Strix flammea*, L.).—*Caves*: Ireland: Edenvale (top level). Celtic: Glastonbury. Roman: Cranbourn Chase, Woodcuts.

SHORT-EARED OWL (*Asio accipitrinus*, Pall.).—*Cave*: Longcliffe.

TAWNY OWL (*Syrnium aluco*, L.).—*Cave*: Langwith Bassett.

LITTLE OWL (*Athene (Carine) noctua*, Scop.).—*Cave*: Chudleigh.

SNOWY OWL (*Nyctea scandiaca*, L.).—*Cave*: Kents Hole.

EAGLE OWL (*Bubo ignavus*, T. Forster).—*Forest-bed*: E. Runton. *Cave*: Langwith Bassett.

BUZZARD (*Buteo vulgaris*, Leach).—*Caves*: Brixham, Clevedon, Ightham.

EAGLE sp. — *River-gravels*: Swanscombe, Kent. *Caves*: Ravencliff, Langwith Bassett, Ightham, Little Hoyle (*Neolithic*).

GOLDEN EAGLE (*Aquila chrysaëtus*, L.). — *Cave*: Perthi-chwareu (*vide* Boyd-Dawkins).

WHITE-TAILED SEA EAGLE (*Haliaëtus albicilla*, L.).—*Cave*: Clevedon. *Fenlands*: Burwell. Celtic: Glastonbury.

GOSHAWK (*Astur palumbarius*, L.).—Celtic: Glastonbury.

SPARROW-HAWK (*Accipiter nisus*, L.).—*Caves*: Ireland: Newhall (top level).

KITE (*Milvus icinus*, Savigny).—Celtic: Glastonbury.

PEREGRINE FALCON (*Falco peregrinus*, Tunst.). — *Cave*: Ightham. Ireland: *Neolithic* in sandhills, Whitepark Bay.

KESTREL (*F. tinnunculus*, L.).—*Cave*: ? Chudleigh. Ireland: Kesh (Plunkett, top level).

OSPREY (*Pandion haliaëtus*, L.).—*Peat*: Walthamstow.

CORMORANT (*Phalacrocorax carbo*, L.).—*Forest-bed*: W. Runton. *Caves*: Clevedon. Ireland: Newhall, Ballingtoy. *Pleistocene*: Grays Thurrock (Essex). Scotland: *Azilian*: Cnoc-sligeach, Oransay, Kit. midd., Caithness. Celtic: Ulrome, Holderness, Glastonbury.

SHAG (*P. graculus*, L.).—Scotland: Shell-heaps or Kit. midd., Oransay, Caithness.

GANNET (*Sula bassana*, L.).—*Neolithic*: Whitburn (Durham).

Ireland : Whitepark Bay. Scotland : Colonsay, Oransay, Caithness, Orkney, Ardsrossan.

PELICAN (*Pelicanus crispus*, Bruch.).—*Fenlands* : King's Lynn, Burwell, Fulwell and Burnt Fen. *Celtic* : Glastonbury.

HERON (*Ardea cinerea*, L.).—*Caves* : Clevedon. Ireland : Ballycotton, Edenvale, Newhall (top level). *Celtic* : Glastonbury.

BITTERN (*Botaurus stellaris*, L.).—*Peats* : Burwell and Reachfens. *Celtic* : Glastonbury.

WHITE STORK (*Ciconia alba*, Bechst.).—*Roman* : Silchester.

GREY LAG-GOOSE (*Anser cinereus*, Meyer).—*Forest-bed* : W. Runton. *Caves* : Langwith Bassett, Chudleigh, Ightham. *Pleistocene brick-earths* : Grays, Ilford, Lawford, Fisherton. *Fenlands, passim* : Scotland : Kit. midd., Ardsrossan, Dalry. *Celtic* species in barrow : Stonehenge. Glastonbury, sp. indet. *Roman* : Silchester. (Eggs have been found in brick-earth at Fisherton near Salisbury).

WHITE-FRONTED GOOSE (*A. albifrons*, Scop.).—*Caves* : Langwith Bassett. Ireland : Kesh (Plunkett, both levels), Edenvale, Newhall.

BEAN GOOSE (*A. segetum*, Gmel.).—*Caves* : Kents Hole, Brixham. Ireland : Shandon.

BARNACLE GOOSE (*Bernicla leucopsis*, Bechst.).—*Cave* : Ireland : Shandon.

BRENT GOOSE (*B. brenta*, Pall.).—*Caves* : Kirkdale, Clevedon. *Peat* : Walthamstow.

DOMESTICATED OR SEMI-FERAL GOOSE.—*Celtic* : Holderness, Glastonbury. *Roman* : Barton, Caerwent, Corbridge, Silchester.

WHOOPER SWAN (*Cygnus musicus*, Bechst.).—*Pleistocene brick-earths* : Grays, Ilford. *Peat* : Burwell and Southery Fens. *Celtic* : Glastonbury. *Caves* : Ireland : Dungarvan, Edenvale.

BERWICK'S SWAN (*C. bewickii*, Yarr.).—*Cave* : Ireland : Shandon. *Peat* : Newport, Mons.

MUTE SWAN (*C. olor*, Gmel.).—*Fens* : near Cambridge. *Cave* : Ireland : Castlepook.

(POLISH SWAN (*C. immutabilis*, Yarrell).—Southery Fen (Brit. Mus. Cat. Foss. Birds, p. 107), but it is a doubtful species at the best.)

TAME OR SEMI-FERAL SWANS have been found in the Celtic village at Glastonbury, and on the Roman sites at Barton,

Corbridge, and Silchester. Ireland: Castlepook, probably recent.

SHELDUCK (*Tadorna cornuta*, S. G. Gmelin).—*Caves*: Kents Hole, Brixham. Ireland: Newhall, Bantick. Scotland: in shell mound, Ardrossan.

DOMESTIC DUCK.—Irish caves generally, and in most Celtic and Romano-British sites.

MALLARD OR WILD DUCK (*Anas boscas*, L.).—*Pleistocene brick-earth deposits*: Grays Thurrock, Fisherton, Bielbacks (Yorkshire). *Caves*: Kirkdale, Clevedon, Wye, Chudleigh, Ightham. Ireland: Kesh, Bantick, Edenvale, Newhall in both levels. *Peat*: Burwell and Southery Fens, Withernsea, Walthamstow. *Celtic*: Ulrome, Glastonbury, St. Catherines, Isle of Wight. *Roman*: Caerwent, Settle, Silchester.

SHOVELLER (*Spatula clypeata*, L.). — *Forest-bed*: W. Runton. *Sub-Arctic*: Mundesley. *Cave*: Ightham fissure. *Celtic*: ? Glastonbury.

PINTAIL (*Dafila acuta*, L.). — *Cave*: Clevedon? Ireland: Kesh (Coffey, low level), Newhall. *Celtic*: ? Glastonbury.

TEAL (*Querquedula crecca*, L.).—*Fens*: Cambridge, *passim*. *Celtic*: Glastonbury. *Roman*: Caerwent, Silchester. *Caves*: Ireland: Newhall (top level).

TERN (*Sterna fluviatilis*, L.).—Scotland: Kit. midd., Oransay.

WIGEON (*Mareca penelope*, L.).—*Cave*: Clevedon? Ireland: Kesh, Edenvale, Newhall, Castlepook. *Celtic*: ? Glastonbury. *Roman*: Silchester.

POCHARD (*Fuligula ferina*, L.).—*Forest-bed*: Ostend. *Caves*: Ireland: Edenvale, Newhall (top level).

TUFTED DUCK (*F. cristata*, L.).—*Caves*: Ireland: Edenvale, Newhall (top level). *Celtic*: Glastonbury.

SCAUP-DUCK (*F. marila*, L.).—*Caves*: Ireland: Castlepook, Kesh (Plunkett, lower level). *Celtic*: Glastonbury.

? GOLDEN-EYE (? *Clangula glaucion*, L.).—*Celtic*: ? Glastonbury.

EIDER-DUCK (*Somateria mollissima*, L.).—*Arctic clay*: Scotland: Stratheden. *Cave*: Ireland: Shandon.

COMMON SCOTER (*Edemia nigra*, L.).—*Cave*: Ightham fissure. Ireland: Kesh (Plunkett, lower level). Scotland: in red Arctic clay, Seaton, near Aberdeen.

SURF SCOTER (*O. perspicillata*, L.).—*Arctic Clay*: Scotland: Stratheden.

DUCK, sp. indet.—*Forest-bed*: Ostend.

RED-BREASTED MERGANSER (*Mergus serrator*, L.).—Lea Valley, Reach Fen. Scotland: Kit. midd., Oransay, Ardrossan. *Celtic*: Glastonbury.

SMEW (*M. albellus*, L.).—*Caves*: Chudleigh. Ireland: Kesh (Coffey, low level). *Peat*: Reach Fen.

WOOD-PIGEON (*Columba palumbus*, L.).—*Caves*: Langwith Bassett, Chudleigh. Ireland: Edenvale, Newhall (both levels).

STOCK-DOVE (*C. ænas*, L.).—*Cave*: Kirkdale.

DOMESTIC PIGEON (*C. livia*, J. F. Gmelin).—*Caves*: ? Langwith Bassett, Chudleigh. Ireland: Edenvale, Newhall, Ballintoy. *Peat*: Newport (Mons.). *Roman*: Caerwent, Silchester.

CAPERCAILLIE (*Tetrao urogallus*, L.).—*Forest-bed*, *Arctic*: Ostend. Teesdale.

BLACK GROUSE (*T. tetrix*, L.).—*Caves*: Kents Hole, Kirkdale, Little Hoyle (Gower). Scotland: Assynt. *Peat*: Newport (Mons.), Kit. midd., Hastings. *Roman*: Corbridge, Settle.

RED GROUSE (*Lagopus scoticus*, Lath.).—*Caves*: Langwith Bassett, Wye, Chudleigh. Ireland: Shandon, Edenvale (lower level), Kesh. Scotland: Kit. midd., Ardrossan and Assynt. *Roman*: Settle.

PTARMIGAN (*Lagopus mutus*, Montin).—*Caves*: Langwith Bassett, Chudleigh. Ireland: Ballynamintra, Kesh (low level) (Plunkett, Coffey).

PHEASANT (*Phasianus colchicus*, L.).—*Caves*: Langwith Bassett, Chudleigh. Ireland: Plunkett, Newhall, Bantick, Edenvale (top). *Roman*: Barton, Corbridge, Silchester. Scotland: Ardrossan.

PARTRIDGE (*Perdix cinerea*, Lath.).—*Caves*: Kirkdale, Langwith Bassett, Wye, Chudleigh. Ireland: Edenvale, Newhall. *Roman*: Barton, Corbridge, Silchester.

QUAIL (*Coturnix communis*, Bonat.).—*Cave*: Chudleigh. Ireland: Castlepook, Newhall (top level).

DOMESTIC FOWL (*Gallus bankiva*, Temm.).—*Caves*: Langwith Bassett, Chudleigh, Berry Head. Ireland: Castlepook, Kesh, Bantick, Edenvale, Newhall. *Celtic*: Barton, Castleton, Glastonbury. *Roman*: Caerwent, Settle, Silchester, Lewes.



TURKEY (*Meleagris gallopavo*, L.).—*Caves*: Ireland: Done-raile, Kesh, Edenvale, Newhall. *River alluvium*: Lea, North London (Dr. Frank Corner Coll.). Located in England by A.D. 1530; when introduced into Ireland is not known.

LAND-RAIL OR CORN-CRAKE (*Crex pratensis*, Bechst.).—*Caves*: Ireland: Kesh, Castlepook, Bantick, Newhall. *Celtic*: Glastonbury.

WATER-RAIL (*Rallus aquaticus*, L.).—*Caves*: Ightham. Ireland: Bantick, Edenvale, Newhall (top levels). Scotland: Kit. midd., Oransay, Colonsay, Ardrossan.

MOORHEN (*Gallinula chloropus*, L.).—*Peat*: Burwell Fen. *Caves*: Ireland: Castlepook, Edenvale, Newhall (top level).

COOT (*Fulica atra*, L.).—*Caves*: Gop (Prestatyn, N. Wales). Ireland: Ballynamintra, Edenvale (top level). *Fens*: Cambridgeshire, *passim*. *Celtic*: Glastonbury.

CRANE (*Grus communis*, Bechst.).—*Fens*: Burwell, King's Lynn. *Celtic*: Glastonbury. *Roman*: Barton, Silchester. *Caves*: Ireland: Edenvale, Newhall. Kit. midd., Ballycotton.

GREAT BUSTARD (*Otis tarda*, L.).—A doubtful find in Norfolk peat.

RINGED PLOVER (*Ægialites hiaticula*, L.).—*Caves*: Clevedon, Chudleigh. *Shell-heaps*: Cnoc-sligeach, Oransay (Azilian), Kit. midd., Ardrossan.

GOLDEN PLOVER (*Charadrius pluvialis*, L.).—*Caves*: Clevedon. Ireland: Edenvale (top level). *Roman*: Caerwent.

GREY PLOVER (*Squatarola helvetica*, L.).—*Cave*: Ireland: Kesh (Coffey) (low levels). *Roman*: Silchester.

LAPWING (*Vanellus vulgaris*, Bechst.).—*Caves*: Chudleigh. Ireland: Bantick, Edenvale, Newhall.

TURNSTONE (*Streptilas interpres*, L.).—*Caves*: Clevedon.

OYSTERCATCHER (*Hæmatopus ostralegus*, L.).—Scotland: Kit. midd., Ardrossan.

WOODCOCK (*Scolopax rusticula*, L.).—*Fen*: Swaffham. *Roman*: Silchester. *Caves*: Ireland: Kesh (Coffey), Newhall (top layer).

SNIFE (*Gallinago cælestis*, Frenzel).—*Caves*: Kirkdale. Ireland: Edenvale, Newhall (both levels).

JACK-SNIFE (*G. gallinula*, L.).—*Caves*: Chudleigh.

DUNLIN (*Tringa alpina*?, L.).—*Roman*: Caerwent.

KNOT (*T. canutus*, L.).—*Cave*: Chudleigh.

REDSHANK (*Totanus calidris*, L.).—*Caves*: Ireland: Kesh (Coffey), Edenvale (bottom level).

CURLEW (*Numenius arquatus*, L.).—*Roman*: Mount Caburn (Lewes).

WHIMBREL (*N. phæopus*, L.).—*Caves*: Clevedon, Chudleigh.

COMMON GULL (*Larus canus*, L.).—*Caves*: Clevedon. Ireland: Ballintoy.

HERRING-GULL (*L. argentatus*, J. F. Gmelin).—Scotland: Kit. midd., Ardrossan.

LESSER BLACK-BACKED GULL (*L. fuscus*, L.).—*Cave*: Ireland: Castlepook.

GREAT BLACK-BACKED GULL (*L. marinus*, L.).—*Roman*: (In D'Urban Museum, Exeter).

RAZORBILL (*Alca torda*, L.).—*Peat*: Burwell Fen. Ireland: Newhall Cave (top level). Scotland: Kit. midd., Caithness, Oransay, Ardrossan.

GUILLEMOT (*Uria troile*, L.).—*Upper Pliocene*: Yarn Hill. Ireland: Edenvale Cave (top level). Scotland: Kit. midd., Ardrossan, Colonsay, Oransay.

GREAT AUK (*Alca impennis*, L.).—*Caves*: Cleadon Hill, Whitburn (Durham). Ireland: Waterford. *Sandhills*: Whitepark Bay, Donegal. Scotland: Kit. midd., Oransay, Colonsay, Caithness.

LITTLE AUK (*Mergulus alle*, L.).—*Caves*: Chudleigh. Ireland: Kesh (Coffey, low level). *Neolithic*: in sands, Whitepark Bay.

ALBATROSS (*Diomedea anglica*, Lyddeker).—*Coralline crag*: Orford, Redcrag, Newbourn, Foxhall. (The red crag bones were compared with, and named *D. exulans* by the late Mr. Gerrard, of the British Museum, to whom I submitted them when the Canham Collection of crag fossils was being transferred to the Ipswich Museum.—A. B.)

WANDERING ALBATROSS (*D. exulans*, L.).—*Pleistocene brick-earth*: Ilford (Thames Valley).

PUFFIN (*Fratercula arctica*, L.).—Scotland: Kit. midd., Ardrossan.

GREAT NORTHERN DIVER (*Colymbus glacialis*, L.).—*Caves*: Ireland: Edenvale (top level).

RED-THROATED DIVER (*C. septentrionalis*, L.).—*Sub-Arctic*: Mundesley, Lea Valley. *Caves*: Ireland: Shandon, Newhall (top level).

GREAT CRESTED GREBE (*Podiceps cristatus*, L.).—*Caves*: Ireland: Kesh (Coffey), Edenvale, Bantick, Newhall (both levels).

LITTLE GREBE (*P. (Tachybaptus) fluviatilis*, Tunstall).—*Celtic*: Glastonbury. *Caves*: Ireland: Newhall, Edenvale (top level).

SHEARWATER (*Puffinus* sp.).—*Celtic*: Glastonbury.

# APPENDIX.

## *Caves (England).*

Brixham, Devon. Pengelly, 'Rept. Brit. Assoc. Adv. Sec.'  
Carnforth, Lancashire. Jackson, 'Lancashire Naturalist,'  
1909-10.

Chudleigh, Devon. Kennard (unpublished).

Clevedon, Somerset. Male, 'Bristol Nat. Soc.,' 1901.

Ightham, Kent. Abbott (locality, E. T. Newton, Fauna).

Kents Hole, Devon. Pengelly, 'Rept. Brit. Assoc. Adv. Sec.'

Kirkdale. Drake & Sheppard, 'Yorksh. Geol. Soc.,' 1909.

Langwith Bassett, Derbyshire. Mullins, 'Journ. Derbys.  
Arch. & Nat. Soc.,' 1913.

Longcliffe, Derbyshire. E. T. Newton & Bemrose, 'Journ.  
Geol. Soc.,' lxi. 1905.

## *Caves (Ireland).*

Ballynamintra, Waterford. 'Trans. R. Dublin Soc.,' 1881.

Co. Clare (Barntick, Edenvale, Newhall). Scharff & Ussher,  
*id.* xxxiii. 1906.

Castlepook (Doneraile). Ussher, 'Rept. B. Ass. Adv. Sec.,'  
1908.

Fermanagh. Kinahan, 'Geol. of Ireland.'

Shandon. Adams, 'Trans. R. Irish Acad.,' xxvi. 1876.

Co. Sligo, Kesh (Plunkett, Coffey). Scharff, 'Trans. R. Irish  
Acad.,' xxxii. 1903.

## *Peats and River Alluvium.*

Cambridge. Skertchly & Miller, 'Fenlands, Past and  
Present.'

Walthamstow, Essex. Woodward, 'Geol. Mag.,' vol. i.

*Shell-mounds and Kitchen-midden refuse-heaps. Azilian and Neolithic.*

- Assynt. Peach, 'Rept. Brit. Ass. Adv. Sec.,' 1892.  
 Ardrossan. J. Smith, 'Trans. Geol. Soc.,' Glasgow, 1891.  
 Caithness. Laing & Huxley, 'Prehistoric Remains in Caithness,' 1886.  
 Colonsay. Grieve, 'Journ. Linn. Soc.,' vol. xvi. 1889.  
 Wright & Peach, 'Geol. Mag.,' 1911.  
 Hastings. Abbott, 'Natural Science Review,' 1891.  
 Oban. Peach, 'Mem. Geol. Survey Scotl.,' 1908.  
 Oransay. Henderson Bishop, 'Proc. Soc. Ant. Scotl.,' xlviii.  
 Whitepark Bay, Co. Antrim. Knowles.

*Celtic Lake Dwellings and Roman Sites.*

*Celtic :—*

- Glastonbury. Andrews, 'Ibis,' 1894.  
 Barton Mere.  
 Ulrome.

*Roman :—*

- Caerwent, Corbridge. 'Archæologia,' 1892 *et seq.*  
 Silchester. *Id.* 1892-1909.  
 Mount Caburn, Woodcuts, Cranborne Chase. Pitt Rivers, separate memoirs, privately published.  
 Crannogs, Ireland and Scotland. Munro, 'Lake Dwellings.'

The 'Vertebrata of the Forest-bed' and 'Pliocene Vertebrata,' both by E. T. Newton, Esq., F.R.S., contains the few references to pre-glacial birds.

The 'Catalogue of Fossil Birds in the British Museum,' R. Lydeker, may be also consulted with advantage.



## NOTES ON THE FAUNA OF THE COUNTRY OF THE CHESH AND GADE.

By T. E. LONES, M.A., LL.D., B.Sc.

(Continued from p. 168.)

### ENTOMOSTRACA.

THESE notes on the Entomostraca relate to work done at two distinct periods, one from the year 1898 to 1902, and the other from the year 1911 to the present time. The original notes for the earlier period have been lost, but I remember some of them sufficiently well to justify making use of a few which happened to relate to the Entomostraca of a few localities of the Gade district, for by far the greatest parts of the notes referred to specimens taken from the country extending from Kensworth and Dunstable on the east to Wendover and Aylesbury on the west. It will be evident, therefore, that the notes for the earlier period will be few and fragmentary compared with those for the later period.

Records of Entomostraca for parts of the country of the Chess and Gade have been made by other workers. These records, so far as I have been able to obtain them, refer chiefly to Watford and Berkhamsted in West Herts. For localities in the Buckinghamshire part of the Chess district I have not succeeded in finding any records. The 'Journal of the Quekett Microscopical Club' does not appear to give any, and the account of the Entomostraca given in the 'Victoria History of the County of Buckingham' refers mainly to Burnham Beeches and Stoke Park.

Fifteen species were obtained from the Watford district by Mr. John Hopkinson about the year 1878, and are recorded on p. 187 of vol. i. of the 'Victoria History of the County of Hertford,' published in 1902. Again, in a paper entitled "The Crustacea of West Herts," printed in the 'Transactions of the

Hertfordshire Natural History Society,' vol. xv., Hertford, 1914, pp. 127-136, Mr. Edward Popple records the occurrence of a comparatively large number of species of Entomostraca. About forty of these are recorded for parts of the country about Berkhamsted, Hemel Hempsted, and Chipperfield. Some of the records above referred to will be mentioned when describing the

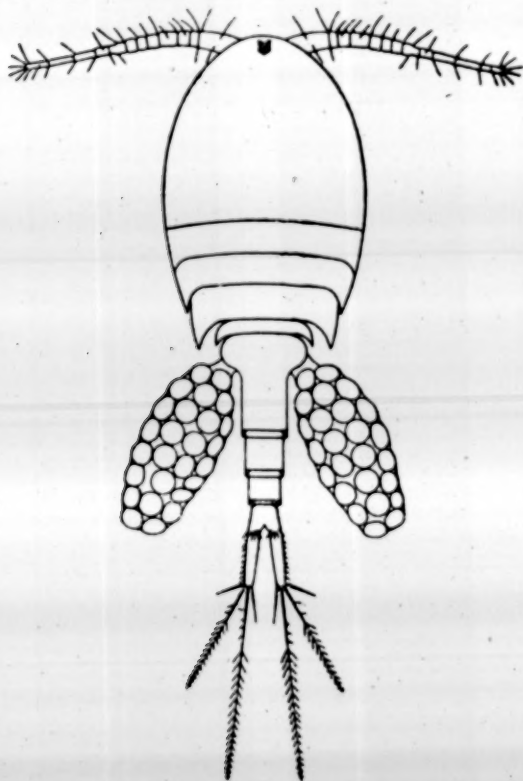


Fig. 21.



Fig. 22.

various species in the following notes, which, like those on the Rotifera, will commence with some of the common species.

1. *Cyclops serrulatus*, Fischer.—Of all the Copepoda of the country of the Chess and Gade this is the commonest. Not only have specimens been obtained from almost every pool and from many parts of the canal, the Chess, and the Gade, but they have been obtained at all seasons of the year. My rough notes contain so many accounts of collections of specimens of this species that it seems best to give the general conclusions which may be drawn from them, limiting the detailed references to those

collections which present features of special interest. A short description of the normal form of *C. serrulatus* will, however, be given first, special attention being paid to structural features which are liable to variation.

Graceful in form, the female has slender and tapering anterior antennæ, which, reaching as far as the third cephalothoracic segment, are only of moderate length; the eighth segment of each antenna is shouldered, and the tenth, eleventh,



Fig. 23.



Fig. 24.

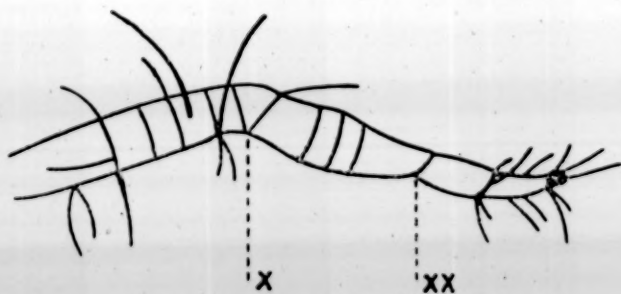


Fig. 25.

and twelfth (see fig. 21) are long and slender. A long and slender abdomen (figs. 21 and 22) terminates in two long and slender furcal segments, which are five times as long as they are wide. The most remarkable feature, however, is a row of short spines bordering the greater part of the outer edge of each furcal segment. These are shown in figs. 21 and 22, and will be called the "combs." Two short setæ, without cilia, arise from the lower part of each furcal segment, and from the end of each segment extend four ciliated cilia of which the fourth or outermost is short, the first or innermost somewhat longer, the third much

longer, and the second longer still and about as long as the abdomen. The cilia of the second and third setæ are strongly developed, but those of the first and fourth are not. The form of the fifth pair of feet is shown in fig. 23, and that of the posterior antennæ in fig. 24. The shape of the red eye and the arrangement of numerous setæ and cilia, not specifically referred to above, can be seen by reference to the various figures. There are two compact, oval, and divergent ovisacs, the angle between their long axes being  $60^\circ$  or more. The colour of the cephalothorax is usually brown or yellow, and that of the ovisacs is usually green. From the tip of the cephalothorax to the extremities of the longest tail setæ is about 1.25 mm. or less than  $\frac{1}{20}$ -inch, and the cephalothorax is about 0.5 mm.

The male is smaller, more slender, and, neglecting its swollen anterior antennæ, more elegant in form than the female. Its movements are very rapid, and each traverse it makes appears to be slightly zig-zag. Each antenna is swollen and hinged so as to form an "elbow" X and a "wrist" XX, fig. 25, to adapt it for use as a clasper. The capability of movement of the "wrist" is very great, as may be seen by narcotizing the Copepod with eucaine when the terminal part of the antenna is seen repeatedly straightening out and then folding down close on to the rest of the antenna. Fig. 25 was drawn from a male obtained from Parsonage Farm Pool. Only a few of the writings on the Copepoda give a drawing of the antenna of the male *C. serrulatus*. The drawing best known to me is fig. 28, plate x. in vol. 24, second part of the 'Bull. de la Soc. Impériale des Naturalistes de Moscou,' 1851, accompanying Sebastian Fischer's account of Copepods from the neighbourhood of Petrograd.

The length of the antenna, when reflexed, is about equal to that of the first cephalothoracic segment. The total length of the male is 0.85 mm., and of the cephalothorax about 0.38 mm.

Proceeding to the consideration of the results obtained from the examination of the very large numbers of *C. serrulatus* from the country of the Chess and Gade, it will be convenient to take in order the following subjects of inquiry:—

1. The relative numbers of specimens at different times.
2. The possible conditions favouring the occurrence of large numbers of *C. serrulatus*.



3. The occurrence of ova-bearing females.
4. The occurrence of males.
5. The occurrence of specimens presenting varieties of form and size.
6. Variations of colour of specimens.

1. *Relative numbers of specimens at different times.*—During every month of the year numerous specimens (including immature specimens) have been obtained. The identification of the immature specimens is difficult and not always satisfactory; they seem, however, to be relatively most numerous in the month of November, and they have also been relatively numerous in the months of April and May. My records for the usually uninviting month of November are fewer than those for other months, but the most noteworthy is one for November 12th, 1913, when thousands of immature specimens of *Cyclops* were obtained from Langleybury Pool; in many of these the combs of *C. serrulatus* were just discernible; not a single specimen with ova was seen. In the same pool, on May 2nd, 1914, there were numerous specimens of *C. serrulatus*, all except a few being immature forms in the Nauplius stage or the Copepod stage, and only one ova-bearing female was seen. On April 28th, 1913, numerous specimens in the Nauplius stage were obtained from Wigginton Pool; in this case, however, there were also many ova-bearing females, and the birth of young ones was proceeding rapidly.

Taking account of adult specimens only, the largest numbers have been obtained in August, September, and October, and large numbers have been obtained in March, June, July, and January.

The above results are based on an examination of the records as a whole. When the yields of any particular locality are considered, it is found that they vary greatly from year to year. Chipperfield Common Pool furnished only a few fully developed specimens on August 2nd, 1912, but a very large number on August 4th, 1913. Nearly a hundred specimens were obtained on September 14th, 1912, and not one on September 15th, 1913; a few were obtained on April 8th, 1913, and none at all on April 11th, 1914. The dates compared in each year are nearly the same, but there were distinct differences in the yields of adult

specimens, and these differences are more striking when it is borne in mind that Chipperfield Common Pool presents more uniform conditions from year to year than most other pools in the district. It seems that in 1912 the time of appearance of large numbers of adult specimens of *C. serrulatus* in this pool was in September, but in the year 1913 it was in the beginning of August.

2. *The possible conditions favouring the occurrence of large numbers of C. serrulatus.*—With respect to the numbers of specimens obtained, different localities in the country of the Chess and Gade, as stated already, have given very different results. A large number, however, have often been taken at a single dredging from the pools of Chipperfield Common, Parsonage Farm, Langleybury, Frithesden, Boxmoor Common, Chorley Wood Common, Whelpley Hill, Cholesbury Common, Coxpond and Wigginton, from the Berkhamsted Castle Moats, and from the Chess at The Moor, Chesham, and the Gade at Great Gaddesden. There are other localities for which the yields have been very poor. Two of such localities, viz. Chesham Road Pool and Bedmond Pool, have yielded, on many occasions, only a few specimens or none at all. Other pools which may be mentioned are those at the brick-kilns, Tyler's Hill, east of Chesham, Hastoe Pool, and Aldbury Pool. From these three pools only a comparatively small number of collections have been made; the pools at Tyler's Hill, it may be said, are not attractive to collectors since, as far as my experience goes, their waters are covered by a film of soot. Of Chesham Road Pool and Bedmond Pool I can speak with greater confidence, for many water samples have been taken from them, and it seems strange that they have given such poor results.

*Cyclops serrulatus* certainly does not seem to be particular as regards its habitat. Height above sea-level, depth of the water, nature of the water, and its situation with respect to sun and wind no doubt influence the life of the Copepod to some extent, but in the country of the Chess and Gade they do not seem to have much effect. Wigginton Pool, 700 ft. above sea-level, has yielded numerous specimens, and so has Langleybury Pool, which is 500 ft. lower; many specimens have been taken from water pure enough for Perch and Trout, and from water foul

enough to suit the rotifer *Hydatina senta*; and the localities above-mentioned, where *C. serrulatus* thrives, vary much with respect to depth of water and exposure to sun and wind. They all agree in having a muddy bottom or masses of *Confervæ* or other small aquatic plants in which the Copepod can readily burrow and take refuge. *C. serrulatus* seems to be very prone to burrow into mud and masses of small aquatic plants when it is disturbed, and this habit I have repeatedly observed when examining the various water samples containing this Copepod; on some occasions, in fact, a few specimens have in this way escaped capture for some time. It seems that the presence of a muddy bottom, or of *Confervæ* or other small aquatic plants, or of floating leaves fallen from adjacent trees is especially favourable to the presence of large numbers of *C. serrulatus*.

Bedmond Pool, which has always given very poor results, rarely presents any of these features. As far as it can be examined from the sides, its bed, which sinks rapidly towards the centre where its depth is said to be over twelve feet, is almost everywhere clean and stony. The poor results obtained from Chesham Road Pool cannot be due to absence of mud, and, in some parts, there is no want of aquatic plants to serve as cover, so that I have been at a loss to understand why more specimens have not been obtained. Examination of the habits of another species of *Cyclops*, of which a moderately large number of specimens have been obtained from the pool, seems to suggest one cause. I refer to *Cyclops fuscus*, Jurine, a stoutly built and aggressive Copepod. Many times I have seen individuals of this species attack others, especially specimens of *C. serrulatus*, with great energy, and ova-bearing females in particular have been left lifeless, or nearly so, after these attacks. The numbers of *C. serrulatus* are no doubt also kept down (and so also those of *C. fuscus*) by the Sticklebacks which are also found in the pool. It may be mentioned that these fishes are also found in Bedmond Pool, which also gives poor yields of Copepods, and these pools of Chesham Road and Bedmond are two of the few pools, altogether unconnected with the streams or the canal, which contain Sticklebacks.

3. *The occurrence of ova-bearing females.*—These have been obtained in every month of the year except November. The

number of records of forms of life taken from the various localities during November of the years 1912 and 1913 is six, and not a single ova-bearing female is mentioned in these records. The number of collections made in November is quite small compared with those of other months, and probably a few ova-bearing females could be obtained, in the early part of the month, in some of the pools. However, it seems to be a fair conclusion that, for ova-bearing females, November is the poorest month of the year. December also has given poor results, except towards the end of the month, while January has always yielded a large percentage of ova-bearing females, *e.g.* on January 27th, 1914, there was a large number of *C. serrulatus* in the small pool at Whelpley Hill, and many of these carried ovisacs, and on January 8th, 1913, eight ova-bearing females were obtained from a small water sample from the pound near the Gade at The Noake, and seven from a small water sample taken from Frithesden Pool on the same date.

The results for February have not been better than those for January. The records for March and, in a less degree, for April show a larger percentage of ova-bearing females than the records for May, which has given comparatively poor yields, although special mention should be made of a collection from Coxpond, on May 24th, 1915, when many such females were obtained. For the month of March there are two records of the occurrence of very large numbers of ova-bearing females. One of these collections was furnished by the Chess at The Moor, Chesham, on May 11th, 1913; the specimens were taken in a square collecting dish, which was scraped along the boards protecting the sides of the river. These boards are covered by a rather thick layer of *Confervæ* and other small aquatic plants, which arrest a lot of fine mud and afford cover to the Copepods. The other collection was obtained from Langleybury Pool on March 26th, 1914. Among the April records reference is made to only one very large collection of ova-bearing females, *viz.* one from Wigginton Pool on April 28th, 1913.

The records for the months June–October show very different results from year to year. Some comments on the liability of many of the pools to be dried up, entirely or to a large extent, have already been made when dealing with the Rotifera. This



drying-up of the pools of course affects their faunas in a very marked degree, and especially during the months referred to above. It is evident that conclusions drawn from work done during a series of a few years only may have to be modified in the light of work done during another series of years. This should be borne in mind when considering the following conclusions based on work done during the years 1912-1915.

Ova-bearing females were particularly numerous in the months of August, September, and October; and although it is not easy to decide which of these months gave the best results, it seems that October yielded the greatest number. The proportion of ova-bearing females as compared with all other adult specimens of *serrulatus* was, however, decidedly greater for September than for either August or October. Some of the pools furnished large numbers of ova-bearing females in June and July, but on many occasions not one was taken during these two months.

The largest number for a single dredging and the largest proportion of ova-bearing females was taken from Chipperfield Common Pool on September 14th, 1912, when sixty-one ova-bearing females and fifteen without ova were taken in one water sample. From the same pool sixteen ova-bearing females and fifteen without ova were taken on October 5th, 1912. Only a small proportion of ova-bearing females was obtained from the Pool on August 2nd, 1912, and August 8th, 1913, and on September 15th, 1913, Chipperfield Common Pool yielded no adult specimens of *C. serrulatus*; on this last occasion the water was low, brown, and turbid, and contained very few weeds. Very many specimens were obtained from the pool, already referred to, on Boxmoor Common on October 16th, 1912, and of these ten carried ovisacs. From a pool near Shire Lane Farm, however, numerous specimens were obtained on October 15th, 1913, and many of these had ova. Other collections which gave a fairly large number of ova-bearing females, and deserve special mention, were from the Gade, at Great Gaddesden, on June 3rd, 1913; Langleybury Pool, on June 18th, 1913; Chorley Wood Common Pool, July 21st, 1913; Langleybury Pool, July 13th, 1915; and Parsonage Farm Pool, August 11th, 1912. Following this last-named collection from Parsonage Farm Pool,

another was made on August 25th, 1912, and only one ova-bearing female was obtained. Many other examples might be given, all tending to show that the Copepod fauna of one and the same pool varies considerably within even short periods.

4. *The occurrence of males.*—I find that my rough notes are not sufficiently detailed to enable me to make any reliable generalized statement as to the months when male specimens of *C. serrulatus* are most numerous. Usually in water samples containing large numbers of this Copepod some males have been found; the largest number, however, of which I have any record or remembrance was taken from a small brook near the first lock on the way from Hunton Bridge to King's Langley on May 13th, 1913. There were plenty of ova-bearing females, but the males greatly surpassed them in numbers. To show the variability of collecting-results, the three following records may be given: (1) Four males and twelve ova-bearing females from Parsonage Farm Pool, on July 1st, 1915; (2) Many ova-bearing females and no males from Langleybury Pool, on July 13th, 1915; and (3) Two ova-bearing females and one male from Parsonage Farm Pool, on July 27th, 1915.

5. *The occurrence of specimens of C. serrulatus differing in form and size from the type.*—It has been due chiefly to a desire to consider this interesting subject in detail that I have collected so large a number of specimens of this Copepod. Numerous water samples have been examined without finding any specimens of *C. serrulatus* differing appreciably from the type. A few of the samples, however, have furnished specimens presenting interesting variations of form and size.

In the Ray Society's Monograph ('The Free-swimming and Semi-parasitic Copepoda of the British Islands,' G. S. Brady, vol. i. 1878, p. 111), a mountain form is referred to differing from the typical *serrulatus* chiefly in its darker colour, and in the less profuse ciliation of the various setæ. On plate 22 of the same volume is a drawing of a female of this mountain form, and such drawing shows neither combs nor cilia. It may be stated at once that I have not found a specimen of this form in the country of the Chess and Gade, but several which tended towards it. These specimens will be dealt with first. On April 8th, 1913, a few females with brown cephalothorax and green

ova were obtained from Chipperfield Common Pool. In most of them the combs were indistinct, and the cilia on the tail setæ were but slightly developed. From the entire water sample only one female with well-marked combs and cilia was obtained. Among a large number of ova-bearing females taken from Wigginton Pool on April 28th, 1913, there were some with combs imperfectly developed. On September 16th, 1913, some specimens from the Cashio beds, Watford, had combs weakly developed; in these specimens the body and ova were nearly white. Imperfectly developed combs were seen in some ova-bearing females obtained from Cholesbury Common Pool on May 26th, 1914, and in some obtained from Coxpond on May 24th, 1915; it should be noted that those from Coxpond were rather unhealthy specimens.

The next to be considered are those adult specimens having the combs, tail segments, setæ, and cilia unusually strongly developed. The combs were very strongly developed in many of the specimens obtained from Boxmoor Common Pool on October 16th, 1912; these specimens had brown bodies usually of a dark shade. On December 30th, 1912, many ova-bearing females were obtained from Chipperfield Common Pool. Their combs were exceedingly strongly developed, and the tail setæ were decidedly longer than usual; the tail segments of these specimens were also longer and more slender than those of any other specimen of which I have any record. In these specimens the cephalothorax was brown, usually of a dark shade. Some specimens, with a light-coloured cephalothorax, obtained from Potten End Pool, on January 8th, 1913, had very strongly developed combs. The tail segments were unusually long in some specimens taken from Wigginton Pool on April 28th, 1913, and the combs were also well-developed. From the same water sample, specimens with imperfectly developed combs were also obtained, as stated already. On September 30th, 1913, Berkhamsted Castle Moat yielded a few specimens with clearly visible combs; one of these specimens had the combs very strongly developed, and the second and third tail setæ were exceptionally long and well ciliated.

When examining the tail segments of specimens of *C. serrulatus* taken from Wigginton Pool on October 15th, 1913, I noticed what seemed to be endo-parasites wandering to and

fro in the segments. They were very small forms of life, oval, about twice as long as they were wide, unicellular, and nearly colourless.

It has been stated already that the angle between the long axes of the ovisacs is about  $60^{\circ}$ , *i. e.* when the female is swimming in plenty of water, otherwise of course the angle may be much less or greater. On September 14th, 1912, a specimen was obtained from Chipperfield Common Pool with the ovisacs nearly parallel instead of being inclined at the usual angle. There was no doubt about its being *C. serrulatus*; its combs were clearly seen, and its antennæ, &c., were those of *serrulatus*.

Most of the female specimens, fully developed and carrying ovisacs, from the country of the Chess and Gade have been about 1.25 mm. long from the tip of the cephalothorax to the extremities of the longest tail setæ. Occasionally specimens decidedly smaller than these have been obtained. On October 5th, 1912, many small ova-bearing females were obtained, together with some of normal size, from Chipperfield Common Pool; and on January 27th, 1914, many small females were obtained from Whelpley Hill Pool, but small as they were their combs and ovisacs were well-developed. From the Chess at The Moor, Chesham, abnormally small ova-bearing females were obtained on March 11th, 1913, and April 28th, 1913. The average size of these was about 1 mm. There is another peculiarity, to be referred to later, about the *serrulatus* of the Chess at The Moor, *viz.* the very light colour of the cephalothorax and the ova.

6. *Variations of colour of specimens.*—Probably no fresh-water Copepod presents more variety in the colours of its cephalothorax and ovisacs than *C. serrulatus*, and in many cases the contrast between the colours of these parts is a very pleasing one. When speaking of the colour of the ovisacs, it should be understood that reference is intended to the ovisac with its full charge of ova, to which the colour is due, for the ovisac itself is colourless and nearly transparent. Not less than one half of the numerous ova-bearing females obtained from the country of the Chess and Gade had a brown or yellow cephalothorax and green ovisacs; as regards the shades, that of the



cephalothorax ranged from straw-yellow in some individuals to sepia in others, and the ovisacs from apple to olive green, grass green being the commonest shade. Specimens with a brown cephalothorax and brown ovisacs have been somewhat common, and chalky waters, like those of the Chess at The Moor and the northern section of the Canal, have yielded large numbers of specimens of *C. serrulatus* with the cephalothorax white or a very pale brown, yellow, or green scarcely distinguishable from white, and with ovisacs white or very pale. Occasional specimens of this last type of coloration have been taken from other localities. Among them were two with milk-white cephalothorax and ovisacs taken on September 12th, 1912, from the brook, already referred to, between Hunton Bridge and King's Langley, some taken from the Cashio beds on September 16th, 1913, with cephalothorax and ovisacs nearly white, and one with pale brown cephalothorax and white ovisacs taken from a pool near Shire Lane Farm on October 15th, 1913.

The above-mentioned three kinds of coloration, viz. brown or yellow cephalothorax contrasting with green ovisacs, brown cephalothorax and brown ovisacs, and white or very pale cephalothorax and ovisacs constitute altogether not less than four-fifths of the total number of specimens examined.

The remaining fifth included some specimens presenting a pleasing contrast of colours. On July 9th, 1912, a very restless *serrulatus* with yellow cephalothorax and cream-coloured ovisacs was taken from Chipperfield Common Pool. From Parsonage Farm Pool one with green cephalothorax and milk-white ovisacs was obtained on September 6th, 1912, and one with straw-yellow cephalothorax and milk-white ovisacs was obtained on September 22nd, 1912. One specimen with olive-brown cephalothorax and milk-white ovisacs was taken from Chipperfield Common Pool on September 14th, 1912.

Finally, some specimens with blue ovisacs of various shades have been obtained. One of these with pale blue cephalothorax and ovisacs was taken from the brook above-mentioned. Another specimen with bright yellow cephalothorax and blue ovisacs was taken from Frithesden Pool on January 8th, 1913, and a third obtained from Langleybury Pool on February 20th, 1913, had bright blue ovisacs.

(To be continued.)

THE RELATION OF THE OYSTERCATCHER TO ITS  
NATURAL ENVIRONMENT.

By J. M. DEWAR, M.D.

(Continued from p. 383.)

IN North Perthshire the average monthly rainfall shows a progressive increase in amount through April, May, and June, the first being the driest month of the year. In April and May the rainfall tends to be evenly distributed over each month, and the water is largely absorbed by the soil. In June the greater rainfall is apt to be concentrated into torrential downpours, and most of the water runs directly off the land into the streams. The loch faithfully registers the increase and the changed character of the rainfall. In April and May the level is falling. Towards the end of May the loch is at bottom level. With the entry of June it begins to rise more or less quickly, according as the rainfall is above or below the average, and is, or is not, torrential in character. The fall and subsequent rise of the loch were well marked in May and June, 1912, the first half of June being excessively wet. At the time of the first laying in the beginning of May, 1912, the level of the loch was 0.6 metre below the winter high-water mark. The level fell another 0.3 metre in the course of May. From June 10th to 17th the water rose 0.7 metre. From this date the level of the loch fell irregularly. Data were obtained for four pairs in as many territories. In one instance the first laying was unknown. In the other three instances both the first and second layings were under observation. The first layings took place in the beginning of May, and all came to grief from various causes. The second layings occurred in the end of May and beginning of June. The relation of the seven nests to the level of the water, and the subsequent histories of the second layings, proved highly interesting. The results are given in the form of a table which is subjoined. The measurements are distances, no means being available to measure the heights of the nests above water-level. The fall of the loch was determined on two posts by the water-

marks visible in the end of May. The subsequent rise was anticipated by marking the posts from the observed lowest water-level.

*Table 2, Showing Positions of First and Second Nests of each Pair Relative to Water-Level: Loch Tummel, 1912.*

Nest A <sup>1</sup> (unknown)	A <sup>2</sup> Below winter H.W.M. 0·9 m. Above water-level, time of laying ... 6·4 m.
Nest B <sup>1</sup> Above winter H.W.M. 1·2 m. Above water-level, time of laying ... 6·7 m.	B <sup>2</sup> Below winter H.W.M. 2·1 m. Above water-level, time of laying ... 6·1 m.
Nest C <sup>1</sup> Above winter H.W.M. ? Above water-level, time of laying ... 6·4 m.	C <sup>2</sup> Above winter H.W.M. ? Above water-level, time of laying ... 6·4 m.
Nest D <sup>1</sup> On winter H.W.M. Above water-level, time of laying ... 6·85 m.	D <sup>2</sup> On winter H.W.M. Above water-level, time of laying ... 10 m.

*Remarks.*—At A<sup>2</sup> the winter high water-mark passed along the grass bank slightly above the shingle. On June 15th, 1912, the bird was flushed from the nest, which contained a pool of water. The margin of the loch was not far from the rim of the nest, the height of which was subsequently fixed at 0·74 m. above water-level at the time of laying. This bird converted the nest hollow into a platform 0·03 m. higher than its surroundings, and continued to incubate. The danger was past after the 17th, and the bird continued to sit. At B<sup>1</sup> and B<sup>2</sup> the position of the winter high water-mark was fixed with difficulty, there being no drift. The second nest was 3·35 m. further down the shore than the first, but the two nests were both situated at similar distances from the water-levels at the respective times of laying. The height of B<sup>2</sup> was later fixed at 0·66 m.; that of B<sup>1</sup> was +0·9 m. above bottom level. On June 17th, 1912, B<sup>2</sup> was drowned out and deserted, being 0·05 m. under water. At C<sup>1</sup> and C<sup>2</sup> the position of the winter high water-mark could not be determined, but judging from collateral evidence both nests were considered to be much above that level. Both nests were equidistant from the water-levels at the time of laying. C<sup>2</sup> escaped the highest flood-level of June 17th with a good margin, the calculated height above bottom level

being 0.96 m. At D<sup>1</sup> and D<sup>2</sup> the winter high water-line was marked by a large quantity of small flood rubbish. Both nests were laid on this line, D<sup>1</sup> slightly above, D<sup>2</sup> slightly below, its centre. D<sup>2</sup> was in no danger, being 0.9 m. above bottom level.

It is evident from the history of these nests that, in any further observations on the choice of nesting site, distance from the water will have to be considered along with height above water. The D<sup>1</sup>, D<sup>2</sup> nests lead one to expect that flood rubbish, when it is present, controls the tendency to follow the descent of the level of the water. The main point, however, which it is desired to bring out has already been stated, and may here be repeated, that the stereotyped behaviour appropriate to the normal laying period, when the rainfall is small and fairly uniform and the level of the loch is sinking, is not so successful in controlling the situation in the different environmental conditions of a later abnormal laying period when the rainfall has increased and the level of the loch is rising.

#### VII.—THE LAW OF TERRITORY.

Each settlement on the south shore of the Forth has an habitual range which it rarely exceeds. Individual settlements have not been known to trespass on each other's feeding-grounds for the purpose of feeding. It is remarkable that from winter to winter the position and total areas of the several territories show no change, and that the occupants of each territory have a similar routine of activities year after year. It has not been found possible to point to any general or specific variation of behaviour, relative to the environment, by comparing the observations of one year with those of another (1906–1914). All the settlements under observation in the Firth of Forth have, in each case, a refuge which is also the headquarters of the station. In places where the refuge is not resorted to at every high water (neap tides, nocturnal high water) and in localities where no refuge is available or necessary, a certain part of the beach, on the high water-mark, is constantly used in preference to other parts as a resting place during high water, and therefore may be regarded as the headquarters. In the Forth the territories are well-defined owing to the intervention of broad bands of neutral shore having little food value. The more



intimate nature of the probable inter-relations of the settlements of a district has been observed in the Aberlady district. The Aberlady, Eyebroughty and Lamb stocks have never been known to visit each other's feeding-grounds for food. The Aberlady and Eyebroughty stocks share Eyebroughty, as a refuge. On one occasion a shooting party was landed on Eyebroughty towards the time of high water, the boat which brought them being sailed about in the vicinity. The Eyebroughty settlement anticipated the boat's arrival by proceeding towards the Lamb, on which they were observed through field-glasses to alight, and where they evidently remained. The Aberlady Bay waders arrived shortly after at Eyebroughty, and were unable to land. They did not proceed to the Lamb, but flew round and round high over Eyebroughty for nearly two hours, until the ebb of the tide allowed them to return and alight safely in Aberlady Bay. After Christmas, when the first signs of nuptial activities begin to appear, visits are exchanged between the Aberlady and Eyebroughty settlements, and between the latter and the Lamb settlement; but, so far as known, never between Aberlady and the Lamb.

As a possible indication of the need of controlling the food-supply for the welfare of the settlement, by maintaining territorial rights, there may be cited the results of a periodical examination of the sizes of shells opened by the Oystercatchers at the Eyebroughty station in the course of winters 1908-1909, 1911, and 1912. The results suggest that, in this area at least, the food-supply is subjected to a considerable strain in meeting the needs of the settlement.

In the Eyebroughty area the average and largest sizes of the mussels showed a continuous fall in the course of the winter 1908-9.

*Table 3, Showing Seasonal Diminution in Size of Opened Shells of Mytilus from "Mussel-Rocks," Eyebroughty: Winter 1908-9.*

DATE.	NUMBER.	AVERAGE.	LARGEST SHELL.
Oct. 29th, 1908	10	3.1 × 1.4 cm.	3.7 cm. long
Nov. 16th, 1908	23	2.25 × 1.0 cm.	2.8 cm. long
Jan. 4th, 1909	....	...	2.5 cm. long
Jan. 26th, 1909	....	...	1.9 cm. long

A considerable proportion of the food-supply at Eyebroughty is derived from the oil-shales in the bay west of Weak Law. The collections made here in the course of the winters 1911 and 1912 show a steady seasonal fall in the sizes of *Tapes* and *Modiolus*, and confirm the results for *Mytilus* in the same area.

Table 4, Showing the Seasonal Diminution in Sizes of Opened Shells of *Modiolus* and *Tapes* from "Shales," Eyebroughty: Winter 1911-1912.

MODIOLUS.			TAPES.	
Date.	No.	Average.	No.	Average.
Nov. 30th, 1911	8	5.0 × 2.5 cm.	6	3.0 × 2.3 cm.
Dec. 11th, 1911	...	...	6	2.6 × 2.2 cm.
Dec. 26th, 1911	8	2.8 × 1.55 cm.	...	...
Dec. 27th, 1911	...	...	32	2.4 × 1.5 cm.
Nov. 18th, 1912	13	4.9 × 2.4 cm.	...	...
Nov. 28th, 1912	...	...	20	2.6 × 2.0 cm.
Dec. 12th, 1912	...	...	15	2.3 × 1.7 cm.
Dec. 17th, 1912	38	2.3 × 1.3 cm.	...	...

The Limpets are more abundant on the shales than are *Tapes* and *Modiolus*. Though they are largely fed upon, the Limpets show great recuperative powers. Grouped in the two fortnightly periods for November, 1912, the results do not show an appreciable change. When, however, separate returns are taken from a fortnightly feeding period, a gradual fall appears in the averages.

Table 5, Showing Seasonal Average Sizes of Limpets fed upon by Oystercatcher: "Shales," Eyebroughty, November, 1912.

DATE.	NUMBER.	AVERAGE.
November 15th, 1912	53	2.2 × 1.5 cm.
November 28th, 1912	66	2.0 × 1.5 cm.
November 12th, 1912	8	2.7 × 2.0 cm.
November 14th, 1912	24	2.3 × 1.4 cm.
November 18th, 1912	19	1.9 × 1.5 cm.

In the summer habitats each pair has an habitual range in a nesting area and in a local feeding-ground. The boundaries, where the range of one pair meets those of adjacent pairs, are elastic; depending, in part, on the presence or absence, at the

moment, of the adjoining pairs. Each station, composed of the breeding area and the local feeding-ground, has a headquarters generally, but not always, situated on a small eminence between the two areas. At the headquarters the birds keep watch and issue challenges. All other birds of the species are driven from the breeding area and the local feeding-ground. The territorial arrangements show no change from year to year (1909-1914). The young at first do not have an habitual range. Where two territories adjoin, the young of one territory are apt to wander into the other until they are called back by their parents or driven away by the other pair. The general or distant (neutral) feeding-ground is apparently common property. All the birds of a district appear to be free of the arable land near the breeding territories, and mingle without signs of hostility. It is, however, probable that closer observation would show that each bird has an habitual range in the general feeding-ground, though there is no apparent tendency to exclude other birds from its range.

Thus the main requirement of the Law of Territory, enunciated by H. Eliot Howard, is fulfilled in the summer environment of the Oystercatcher. The law should be extended to apply to the birds in winter, as they then have territories, though no opportunity has come under notice of a territory needing to be defended against intruders. The mode of acquiring the winter territory is unknown. In summer, the method differs from that observed by Howard in British Warblers, as Seton Gordon records that the birds ascend the rivers in pairs. My own observations indicate pairing to take place on the sea-coast. The subsequent course of events nearer the breeding territories is not known. Howard's view that the possession of territories is a biological advantage both to the individual and the species, by securing an adequate, and no more than an adequate, supply of food, is borne out by the general evidence derived from the areas under observation, and by the results obtained at Eyebroughty.\*

(To be concluded.)

\* H. Eliot Howard, 'The British Warblers,' part iii., 1909; Part v., 1910; Part ix., 1914. Seton Gordon, 'Birds of the Loch and Mountain,' p. 97.

## NOTES AND QUERIES.

## MAMMALIA.

**Leisler's Bat in Somerset.**—On October 13th a Bat was brought to me by my gardener, who caught it flying about in the kitchen of his cottage, which a reference to Barrett-Hamilton's and Hinton's excellent work on 'British Mammals' showed to be an example of Leisler's Bat (*Nyctalus leisleri*). In view of the comparative rarity of this Bat in this country, I sent it up to Mr. Martin Hinton at the British Museum, who has very kindly confirmed the identification. As the Bat does not appear to have been recorded before from the Mendip district of Somerset, I think its occurrence worth noting.—J. WIGLESWORTH (Winscombe, Somerset).

## AVES.

**Mandarin Ducks at Woburn; Pheasants Feeding in Trees.**—I have not noticed Mandarin Ducks eating acorns, but of course they sit a great deal in trees and breed in them. They are thoroughly established at Woburn, and seem to stray very little. They did not do at all well until we left them unpinioned. They have large broods, and a large proportion of them seem to survive the perils that most young ducks succumb to. We now reckon them one of our most successful importations amongst birds. During the last few days I have on three occasions seen Pheasants sitting in apple-trees eating apples. I do not know whether this habit has been often observed.—M. BEDFORD (Woburn Abbey).

**Late Nesting of Cirl-Bunting in Somerset.**—On August 13th I found a Cirl-Bunting's nest with five hard-set eggs. The usual breeding-time here is the end of May or early June. The nest of this species seems to contain five eggs more frequently than that of the Yellowhammer, which seldom lays more than four in this district.—JOSEPH H. SYMES (Coat, Mastock, Somerset).

**Localized Occurrence of Black-backed Gulls.**—Referring to Mr. Patterson's interesting notes (p. 372) it seems curious that the Lesser Black-backed Gull should be so uncommon at Yarmouth, while at



Lowestoft a few weeks before now (October 17th) it was to be seen every day. Lowestoft Pier is now in the hands of the naval authorities, and sometimes on a rough day I used to get into a sentry-box at the east end to watch the Gulls. Some fine old Lesser Black-backs would come quite close, especially when there had been a turn-out of refuse, which attracted a swarm of voracious sea-rovers. I could not identify the Kittiwake or the Great Black-back, but there was no doubt about the other four British-breeding Gulls. Having committed myself to a lantern-talk on "Our Summer Migrants" during the coming winter, I asked a friend who is well up in East Coast migration whether the Lesser Black-back might fairly be included, as I possess a very good picture of a group taken on the Farne Islands. His opinion was that it certainly might, as it was never to be seen in mid-winter, when the Great Black-backed and Herring Gulls are more abundant than at any other time.—JULIAN G. TUCK (Tostock Rectory, Bury St. Edmunds).

**Gannet Nesting in Orkney.**—I am informed by a correspondent that a pair of Gannets nested in 1914 on the Horse of Copinsay, off the east coast of Orkney. There was no news of the birds this year; but as a lighthouse is now being built, it is not likely that the birds have bred there this season.—O. V. APLIN (Bloxham).

**Some Notes on the Nesting of a Pair of Moorhens:—**

*April* 12th.—Moorhens commenced constructing a nest on some overhanging bushes, placed for that purpose at the side of a pond in my orchard. The nest is about eighteen inches above present water-line.

20th.—This nest appears never to have been further completed, except perhaps a very few additional pieces of rush have been added.

*May* 5th.—A second nest has been built on some dead bushes alongside brook, thirty yards distant from the other nest at the pond, and now contains three eggs.

7th.—7.30 p.m., a storm in the evening washed away the nest and eggs. Another nest, formed on the top of a stub amongst an accumulation of sticks and other refuse, found the same afternoon, a distance of two hundred and twenty-five yards above stream. I never saw a bird at this nest afterwards.

9th.—8.30 a.m., an egg in the first nest at pond.

11th.—6.30 a.m., still the one egg only, but the position of it has been altered. 6.30 p.m., egg removed.

17th.—An additional nest on the bushes over pond, some seven feet away from other nest.

18th.—6.30 p.m., two eggs in the new nest.

19th.—1 p.m., two eggs. 7.30 p.m., three eggs.

20th.—7 a.m., three eggs. 5.30 p.m., four eggs.

21st.—5.30 p.m., four eggs, and hen bird flushed from the nest. 5.34 p.m., she returned to her nest. 6.30 p.m., five eggs. It is evident this bird lays her eggs between 5 and 6 o'clock in the evening. From investigations made subsequently with other Moorhens, it seems probable that their eggs are usually laid about this time of day.

22nd.—Sixth egg laid, and the last one of the clutch.

June 10th.—6 p.m. to 8 p.m., I could hear at some little distance from the nest the cheeping of a young one within one of the eggs.

11th.—7 a.m., one young Moorhen hatched. 3.30 p.m., two young ones hatched, one of which descended on to the water eighteen inches below the nest.

12th.—Four young hatched; two addled eggs left in nest. Incubation therefore appears to be about twenty days in duration.

14th.—All the young take freely to the water.

17th.—The first nest, constructed on April 12th, has now been made up with some fresh green rushes, and it is now used as a roosting-place by the hen bird and her young. The cock bird sleeps close at hand at the pond also.

24th.—The adult birds during the daytime take an equal share in their attention to the young. Either of the parent birds may be observed accompanied by one or more of the young busily searching the pond, brook, or adjoining grassland for their food.

25th.—I came rather suddenly upon the Moorhens with their chicks feeding in the orchard among the newly-mown grass; the young immediately sought cover under the swaths, the old birds walked sedately down to the pond without giving the least indication or betraying any anxiety that their young were present. The two addled eggs are missing from the nest in which the young were reared.

26th.—I killed with a rifle a Rabbit that was feeding within a few yards of one of the Moorhens and its young. The Moorhen was from its actions evidently very surprised at the collapse of the Rabbit without apparent cause. It went up to the dead Rabbit and walked around within about eighteen inches of it, and spent some considerable time trying to satisfy its curiosity. The young Moorhens are now showing a very independent spirit, and can often be seen foraging about the grassland unaccompanied by either parent.

When alarmed they run to the pond, and have become very expert at diving. They can already progress some yards under water.

29th.—4.15 a.m., one of the parent birds very busy stealing hay for its nest from a hay-cock near by. This continued for fifteen minutes, and each visit was made practically every twenty-five seconds. After completing what was necessary to the nest, a Rabbit feeding some short distance away was driven from the vicinity of the pond; perhaps the possible repetition of the former mystery was not welcomed.

July 8th.—The young are now frequently seen at considerable distances from the pond.

13th.—The hen bird and young always retire to the roosting-nest much earlier than the male bird returns to sleep at the pond.

16th.—Raining steadily. The young retire to sleeping-nest at 6 p.m., but leave it again for a short time at 7 p.m.; as a rule they settle down for the night fully an hour later.

19th.—Heavy rains the last few days. The nest further added to with more grass and rushes.

20th.—5.30 p.m., watched further building up of the nest. I have never seen both birds at work together, and I think it is only the hen bird that constructs the nest.

22nd.—4.30 a.m., the old bird again adding to nest. 4.45 a.m., the first young one left the nest, followed by another at 5 a.m.

23rd.—4.30 a.m., hen bird first left her brood; the latter remained in nest for some time after.

27th.—Further nest construction.

August 3rd.—Two of the four young appear to be missing.

4th.—Heavy rain. Roosting-nest now completely under water. The nest in which the young were hatched has been considerably added to, and is now being used for roosting purposes. The other nest was never reoccupied, although the water was at its normal height again a few days afterwards.

16th.—From August 3rd a Stoat has made almost daily visits to the pond (see 'Zoologist,' September, p. 354). At such times the old birds call the young quickly to the water, and keep them well in the centre out of harm's way, calling with loud alarm notes in the meantime.

20th.—Old bird ceased to roost with the young about this date. The care of the young has lasted about ten weeks.

28th.—A fifth nest has been constructed near by where the flood washed away their first nest and eggs, but I cannot see that it is put to any purpose.

September 4th.—One young one only now roosts in nest.

8th.—A sixth nest constructed along brook side near where the nest was formed in top of alder stub. This nest also I cannot ever find occupied.

25th.—Both young first seen to take to the wing. It is now fifteen weeks since they were hatched.

30th.—The two young seen roosting on the brood nest for the last time. The old birds have only visited the pond during the day for some time past.—J. STEELE ELLIOTT (Dowles Manor, Shropshire).

Ring-necked Parrakeets (*Palæornis torquatus*) at large in London.—Two of these birds haunt the neighbourhood of Clissold Park, N.; whether they are a pair or not I cannot say, but regularly every morning, at 8.15 or thereabouts, one can see them; they attract one's attention by their screaming. At first I could not locate them, owing to their quick flight, but can now detect them immediately; they always seem to fly in the same direction, due north, at the above time. I have never seen them at any other time than in the morning; whether they go away and return later I cannot say.\*—C. T. NEWMARCH.

Grey-breasted Variation in Robin.—On September 19th, and again on the 22nd, and on two occasions since, I observed in the Zoo among the bushes at the back of the Diving-birds' House, a Robin which had the red confined to the face and throat, the rest of the area which is commonly red being slate-grey. The rest of the plumage was normal, and the bird was adult.—F. FINN.

Yellow Bill in Female and Young Blackbirds.—For some years past I have noticed the common occurrence of a yellow bill in hen Blackbirds in our London Parks; it is now, I think, the rule for the hen to have a yellow bill, though not quite so bright as the cock's, and I have noted this during the present year in localities as far apart as Regent's Park and Kew. About mid-summer I saw at the back of the Zoo library a newly-fledged young bird with a yellow beak, so this local variation looks like extending further.—F. FINN.

\* A male Parrakeet of this species was seen by us on more than one occasion in a recent summer at the south end of Regent's Park, apparently quite at home; there has been also a bird of this genus in Hyde Park for a year or two, which we have seen at a distance, but we are not sure if it is the common Ring-neck, or one of the races of the large and distinct "Alexandrine" Parrakeet (*P. eupatrius* group).—Ed.



## ASTEROIDEA.

Common Starfish Attacking *Syngnathus acus*.—It has already been recorded in 'The Zoologist' for April and June, 1915, that the Common Starfish (*Asterias rubens*) has eaten dead or dying *Æquoreal* and Broad-nosed Pipe-Fishes of ten and twelve inches in length. A Starfish has since been seen to seize a strong and vigorous Great Pipe-Fish (*Syngnathus acus*) of eighteen inches in length. The Pipe-Fish, which threw its body into vigorous contortions when it was taken in the hand, was dropped into an aquarium containing two Starfishes, as it was not deemed possible that the latter could or would attack so large and strong an animal. The Pipe-Fish, as it fell through the water, passed a Starfish, which was clinging to the vertical rockwork of the aquarium. When the fish reached the bottom it lay still, perhaps a little fatigued with its four hours journey in a collecting-can from the coast. The Starfish, which was about six inches away, almost immediately began to descend quickly and directly towards the fish, with the slender terminal tube-feet of its foremost rays waving in the water in the manner characteristic of these tube-feet when the Starfish is advancing towards food. When the Starfish reached the Pipe-Fish it moved upon the latter in such a way that it embraced the whole head and fore-part of the fish with two rays. The Pipe-Fish did not move until the Starfish had affixed a number of tube-feet of each ray to its body. The Pipe-Fish then gave several violent jerks, but to the astonishment of myself and another observer it was unable to get free. The two animals were lifted out of the water and separated, the Pipe-Fish being placed in another aquarium.—H. N. MILLIGAN.

Rate of Locomotion in a Sun-Star.—It seemed desirable to ascertain the average rate of locomotion in a small Sun-Star (*Solaster papposus*), measuring two inches from tip to tip of opposite rays, which has been living in an aquarium for twenty weeks. This was somewhat difficult owing to the fact that the animal did not usually maintain a straight course, but on twenty-three occasions it was found possible to make measurements. It was observed that when it was moving along the side (of slate) or front (glass) of the aquarium with one ray just touching the surface of the water, it would often advance in a straight line, and the majority of the following measurements were made on such occasions. This Sun-Star has a habit of very suddenly reversing the direction of locomotion, and this has made it possible to determine the times and measurements with accuracy. The records were as follows:—12 inches

in 320 seconds, 8 in 180, 8 in 240,  $6\frac{1}{2}$  in 180,  $14\frac{1}{4}$  in 360,  $3\frac{1}{2}$  in 90,  $4\frac{1}{2}$  in 120,  $9\frac{1}{2}$  in 210, 6 in 150,  $8\frac{1}{2}$  in 180,  $6\frac{1}{4}$  in 150,  $5\frac{1}{2}$  in 150, 5 in 180, 4 in 95, 13 in 360, 18 in 400, 12 in 380,  $5\frac{1}{2}$  in 135,  $13\frac{3}{4}$  in 375, 11 in 300, 12 in 255, 5 in 100, and 6 in 135. It can readily be calculated from these figures that the average rate of locomotion was 1 in. in 26.1 seconds, the fastest rate recorded being 1 in. in 21.1 seconds, and the slowest 1 in. in 38.5 seconds.—H. N. MILLIGAN.

#### CRUSTACEA.

**Spider-Crabs Fastening Beef to their Bodies.**—On three occasions within six weeks it has been observed that the Long-legged Spider-Crab (*Stenorhynchus phalangium*) has fastened during the night pieces of beef, given to it for food, in the hook-like setæ upon which it usually affixes the disguising materials. One individual affixed a piece of about a quarter of an inch in diameter to its rostrum on the night of July 20th–21st, 1915. Another affixed a piece of about the same size to one of its legs on August 19th–20th, and a piece to its rostrum on August 27th–28th. All three pieces disappeared within two or three days, having apparently been eaten by the Spider-Crabs. Pieces of animal matter could hardly be of use as a disguise, and indeed would probably be exceedingly dangerous, inasmuch as they might attract enemies. Several weeks residence in an aquarium, in which the Spider-Crabs were immune from attacks of other animals, may have had something to do with their curious behaviour, but it must not be forgotten that Spider-Crabs will sometimes use their disguising materials (seaweeds, zoophytes, &c.) as portable larders upon which they can draw when they are without the reach of food. H. N. MILLIGAN.

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#### NOTICES OF NEW BOOKS.

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*The Alligator and its Allies.* By ALBERT A. M. REESE, Ph.D.  
New York and London: G. P. Putnam's Sons. 1915.  
10s. 6d. net.

THIS exhaustive and fully-illustrated work is one of a type which ought to be far more common—the intensive working-out of the characteristic of a single species, with due reference to its various allies; Mivart's fine work on the Cat being a well-known example. Dr. Reese gives us a brief review of the Crocodilia as a whole, and a special account of the life-history

and habits of the American Alligator (*Alligator mississippiensis*); then follow several chapters devoted to the anatomy, skeletal, muscular, nervous, visceral, &c., and finally an account of the embryology of the Alligator and a bibliography. The frontispiece is a colour-photograph of the Alligator.

We are rather surprised to find that the chapter on the muscular system is, as stated in the preface, a translation from Bronn's 'Thierreich, and that the descriptions therein have not been verified by Dr. Reese, especially as he says in this chapter that Bronn in turn has followed Gadow, and that the reptile described in this German work is a Crocodile (of a species not particularized) and not either of the two known Alligators, the American, or the Chinese *A. sinensis*. It would surely have been better to defer the publication of the work until the muscles of American Alligators could be worked out; the author's position as professor of zoology in the West Virginia University should have facilitated the research, and though, as is stated, "it is probable that the differences between the various members of the Crocodilia would be slight," we consider the method of treating a scientific subject on the principle "one is as good as another," a decided blemish. The figures of the muscular system, however, we are told, are "mainly from the Florida Alligator." The bionomical part of the book contains observations of much general interest; Dr. Reese has found Alligator-meat decidedly palatable, and wonders why it is not more used; the reptile has also much economic value as a leather-producer, hides of seven feet being most in demand. Compared with some old-world Crocodiles and with the American Crocodile (*Crocodilus americanus*), the Alligator is a very harmless reptile, and is even beneficial in keeping down Cane-Rats and Musk-Rats, so that, in view of its economic value, protective legislation has been suggested and is recommended.

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*Country Sights and Sounds.* By G. T. ROPE. London: Constable & Co., Ltd. 1915. 3s. 6d. net.

THE sketches in this pleasant little book have, so the author tells us in his preface, mostly appeared in various publications concerned with nature, some in fact, in the 'Zoologist,' and Mr. Rope's useful and exhaustive contribution

last month on abnormal tastes in the Cat is evidence of genuine observation.

The manner in which he deals with some of his subjects, such as habits of homely domestic creatures like Fowls and Pigs—so generally neglected by modern naturalists—reminds one much of the inimitable style of J. G. Wood, a quotation from whose admirable 'Illustrated Natural History' faces the title-page. The author's writing, indeed, has no need of the modest apology contained in the preface, and although some of the chapters may fairly be called "slight," it would be most unfair thus to stigmatize the work as a whole. It is well got up, on rough paper—so much pleasanter to look at than the modern shiny stuff—and is not illustrated, a distinct point in its favour, for the subjects do not call for illustration, and nothing gives a more catchpenny aspect to a book than pictures which do not enlighten.

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*The Wonders of Animal Life.* By W. S. BERRIDGE, F.Z.S.  
London: Simpkin, Marshall, Hamilton, Kent & Co., Ltd.  
1915. 6s. net.

THE illustrations, on the other hand, are the main feature in Mr. Berridge's book; they number about a hundred, and, though far too generally lacking in definition, and so not very useful for giving an accurate idea of the mostly unfamiliar creatures they naturally represent, are for the most part very good in pose, testifying to plenty of patience on the part of the photographer. Some of the best are those illustrating the courting or other displays of birds; besides the familiar "show" of the Peacock and Turkey, we have here that of Peacock-Pheasant, Great Bird-of-Paradise, Sun-Bittern, and Great Bustard. Good photographs of such rare animals as the Tuatera, Royal Antelope, Tasmanian "Wolf" and Devil, are also welcome. Mr. Berridge's text is readable, though poor in style, and he covers a very wide field in his compilations; but he is sometimes deplorably careless, as when he calls the beaks of the Echidna and Platypus appendages to the snout, whereas they are the snout itself, and credits the male Apteryxes with being slightly larger than the females, when they are really very considerably smaller.

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ERRATA.—Page 374, for "May" read "September."

